Middle Articles

HOSPITAL TOPICS

What Price Anaesthesia? An Investigation into Costs

A. MURRAY WILSON,* M.B., CH.B., F.F.A. R.C.S.

Brit. med. J., 1966, 2, 1190-1192

At a time when all costs are increasing it is most interesting and instructive to consider the economics of anaesthesia and the relation of the cost of the specialty to other hospital expenditure. The anaesthetist, along with all other hospital staff, is encouraged and exhorted to economize. He can do this only with a full understanding of where expenditure occurs. With this knowledge the possibilities for economy, if any, should become apparent. The cost of administering one anaesthetic is the sum of many individual costs. Of these, expenditure on medical gas and anaesthetic drugs is measurable directly; other costs, such as technical help, cleaning, lighting, heating, portage, and laundry, are impossible to determine with any degree of accuracy, as they are inseparable from the costing of theatres and the hospital in general.

The difficulties facing a cost accountant attempting to separate anaesthetic expenditure from other hospital services are immense. To take just two examples: How is the theatre heating cost to be proportioned? Should it be on the relative size of anaesthetic and operating-rooms, or perhaps on the relative time spent in each? Is the theatre porter bringing the patient for anaesthesia or for surgery? Whereas it is possible to cost a central sterile-syringe unit where there is physical demarcation, it is impossible to do so for anaesthesia, which extends into many other departments. In this discussion, therefore, I am choosing to concentrate on those charges over which each individual anaesthetist has some control, and which are dependent on his particular technique.

Cost of Anaesthetics

All the figures quoted refer to the year ending March 1964 in a 550-bed provincial teaching hospital, one of a group, and taking one-third of the total group expenditure.

Anaesthetics are administered in a suite of general surgical theatres, of which two or more are in use continuously during the day, and in separate neurosurgery, E.N.T., ophthalmology, radiotherapy, and casualty theatres. An outlying psychiatric department is covered for E.C.T. sessions. It is necessary to establish some basic figures with which comparison may be made. These have the disadvantage of being generalizations, but without the benefit of extensive cost analysis this is the best that can be obtained, and does permit of easy comparison with other hospitals having similar facilities. One such term is the bed/day cost derived from

Total annual expenditure

Average number of beds available per day $\times 365$.

This is an unsatisfactory figure, as it assumes that all expenditure is directed towards inpatients. However, many outpatient sessions of this hospital are held at a building costed separately.

* Registrar, United Sheffield Hospitals.

The total annual expenditure (Table I) represents a bed/day cost of £5 14s. The total drug bill is 4.95% of the total expenditure, representing 5s. 8d. per bed/day. The item for blood is approximately 110 bottles per week, at roughly £12 per bottle, but does not include fresh blood used for open-heart cases, of which there are one or two weekly. The number of anaesthetics is the total given in all departments, whether by specialist anaesthetists or by house-officers (in the casualty department). This practice has now ceased, and all anaesthetics are administered by trained anaesthetists.

TABLE I.—Total Expenditure for Year Ending March 1964

Total hospital expenditure	£1,114,105
Total drug bill	53,200
Blood	68,600
Provisions	58,000
Average daily available beds	533
No. of operations under G.A.	8,250
" " surgical inpatients discharged (all specialties)	8,563

TABLE II.—Drugs Analysis for Year Ending March 1964

Halothane	£3,531	37.1%	Penicillin	£3,638
Other anaesthetics	1,013	10.6%	All other antibiotics	5,373
Muscle relaxants	504	5.3%	All corticosteroids	8,198
Addictive analgesics	225	2.5%	Antihypertensives	8,062
Medical gases	4,258	44.5%	Perfusion fluids	1,034
Anaesthetic total	9,531	100%	X-ray substances	1,128

Table II shows some items of the drug bill, with those related to anaesthesia in the left-hand column, those on the right being presented for comparison. "Other anaesthetics" include intravenous anaesthetics, trichlorethylene, and ether. "Addictive analgesics" are used mainly for pre- and post-anaesthetic medication, but also include medical ward usage, and so the total cost is not entirely chargeable to anaesthesia. The same is true of medical gases, where it proves impossible to separate ward from theatre use. The figure of £4,258 is the total for nitrous oxide, oxygen, carbon dioxide, and cyclopropane. Of these, only oxygen is used in the wards, and there was no intensive-care unit at that time. It may be assumed that £4,100 to £4,200 represents anaesthetic usage. All gases are supplied from cylinders, there being no piped-gas installation. Thus the estimated total year's expenditure on anaesthetic drugs can safely be taken as £9,500, or 17.8% of the total drug bill. For a total of 8,250 anaesthetics this means an average cost of £1 2s. 9d. per anaesthetic, or at 5s. 8d. per day the cost of four days' medication.

The outstanding figure is that of halothane. Shackleton (1960) showed the effect of the introduction of halothane on anaesthetic expenditure, but spending 37% on one item is still difficult to justify. A sum of £3,531 buys 43 bottles of 250 ml. per month, at £6 8s. 6d. each, or approximately £10 per day, the cost of 350 ml. This seemed rather a lot, and it appeared that waste might be occurring. On calculation it is found that

350 ml. of liquid is vaporized to a 1% mixture at 9 l./min. in 20 hours. This compares favourably with the consumption that might be expected in seven theatres, each working daily. Nevertheless, it is useful to remember when filling vaporizers that each millilitre spilt costs 6d.

Cost of Individual Anaesthetic Techniques

To present the cost of individual anaesthetic techniques I have selected a sample range of operations. The basic figures used for calculating these (Table III) are derived from the

Premedication	Atropine, 0.6 mg.	1.1d.
	Pethidine, 100 mg.	1.9d.
	Omnopon, 20 mg.; and scopolamine, 0.4 mg.	1.9d.
Induction	Thiopentone, 0.5 g. with water	1s. 11d.
	Suxamethonium, 100 mg.	4d.
	*Endotracheal tube	2s. 6d.
Maintenance	Nitrous oxide, 6 l./min.	1d. }
	Oxygen, 3 l./min.	1d. per }
	Halothane { 1% at 9 l./min.	2d. min. }
	Gallamine { 80 mg.	1s. 0d. }
	{ 120 "	1s. 4d. }
	d-Tubocurarine, 15 mg.	1s. 10d. }
	Pethidine, 100 mg. in 10 ml.	1s. 9d. }
Reversal	Atropine, 0.6 mg.	1.1d.
	Neostigmine, 2.5 mg.	7d.
Postoperative—	Omnopon, 20 mg.	1.7d.
Syringes (disposable,	2 ml.	2.8d.
1966 price)	5 "	4.6d.
	10 "	5.8d.
	20 "	8.2d.
Needles,	Injection	1.7d.
disposable	Filler	2.7d.
Blood-transfusion set, disposable		9s. 0d.
Aqueous perfusion fluid, pint		2s. 8d.

* Endotracheal tubes costing 15s. and lasting an average of six autoclavings (Stark and Pask, 1962).

flow rates in most common use in this hospital. All machines are fitted with accurate halothane vaporizers. Drug prices are those negotiated by contract, and will be seen to vary only slightly from those recorded by Shackleton (1960). The cost of the central sterile supply department syringes could not be

estimated, and so present-day prices of disposable syringes and needles have been substituted. This, I think, is valid, as drug prices remain stable. The Chart shows the cost of expendable anaesthetic materials for six operations.

Anaesthetic Personnel

Having demonstrated that the cost of consumable materials during an anaesthetic is remarkably low, we may turn to the cost of staffing. Surgeons are prone to raise their eyebrows if more than one anaesthetist appears, forgetting that they may operate with a number of assistants, including one or two of

the nursing staff. I have therefore attempted to compare the work done in the theatre by anaesthetists and surgeons (Tables IV and V). Lest invidious comparisons be made, I have calculated this from the theatre sessions. Over one year this gives session-availability for each grade.

TABLE IV.—Anaesthetists

Consultants	..	34 weekly sessions × 46 weeks = 1,564 p.a.
1 senior registrar	..	11 " " × 46 " = 506 "
3 registrars	..	33 " " × 48 " = 1,584 "
1 S.H.O.	..	11 " " × 48 " = 528 "
Total anaesthetist sessions in one year		4,182
No. of general anaesthetics per year		8,250

From Table IV the extraordinarily low figure of 2.0 cases per anaesthetist session is obtained. This overall figure takes into account cardiac surgery and neurosurgery, where one case, or even half a case, per session is the rule. It takes no account of sickness, study leave, teaching sessions, and the junior S.H.O., who must be supervised in his early stages. Registrars are normally allowed two study sessions per week, and senior registrars one research session. Nevertheless, it does represent the productivity per anaesthetist.

To calculate surgical session availability, only consultants and registrars have been included. House-surgeons are assumed to be "optional extras," as they are often called to the wards.

TABLE V.—Surgeons

Consultants	..	37 weekly sessions × 46 weeks = 1,702 p.a.
Senior registrars	..	18 " " × 46 " = 828 "
Registrars	..	35 " " × 48 " = 1,680 "
Total surgical sessions in one year		4,210

If allowance is made for operations under no or local anaesthesia the productivity rate is just two cases per session. This refers only to time spent in the theatre. No mention is made of other work either by anaesthetists or by surgeons, and for this reason alone comparisons may be made.

Cost of Staffing

Of the total expenditure gross salaries of medical staff accounted for 18.2% in this group, of which anaesthetists draw approximately £20,000 from this hospital. This figure includes consultant sessions within the hospital but not in the theatre, and produces a net cost of £2 8s. per anaesthetic.

Discussion

I have shown that the cost of each anaesthetic is in the region of £3 11s. for anaesthetist and drugs. Shackleton (1960) showed a cost of £2 11s. 7d. for the same two items in 1959, and commented upon the "economic modesty of the specialty." His figures refer to a provincial non-teaching hospital, where the cost of staffing might be expected to be lower. These five years include a salary increase, and were the two hospitals comparable the higher cost would represent an increase of 7% per annum in unit cost.

Jones (1957, 1961), in making a comparison between anaesthetic costs at the Groote Schuur Hospital in 1955 and 1960, showed an overall increase of 30% on the cost of each anaesthetic in five years (Table VI).

TABLE VI.—Comparison of Costs

	Staff (Medical)	Drugs	Unit Cost
Jones { 1955 ..	£1 4s. 6d.	12s. 6d.	£1 17s. 6d.
1960 ..	£1 16s. 3d.	16s. 3d.	£2 12s. 6d.
5-year increase ..	48%	30%	42%
Shackleton, 1959 ..	£1 17s. 0d.	13s. 9d.	£2 11s. 7d.
Present investigation ..	£2 8s. 0d.	£1 2s. 9d.	£3 11s. 0d.
5-year increase ..	24%	64%	36.5%

The comparisons given in Table VI appear to be the only two similar investigations into anaesthetic costs, but Seale (1959, 1960a, 1960b) has written on the theoretical aspect of health expenditure.

Economy.—As was indicated earlier, many costs are fixed by reason of architecture, etc. The only ways in which economy can be effected, if indeed it should—and my figures would not support this view—are by reducing expenditure on drugs and by better employment of personnel. Comparison of theatre work load would indicate that anaesthetists are pulling their weight as well as their surgical colleagues. The case per session ratio may seem low, but this is a teaching hospital with an established registrar training scheme. It would be most interesting to draw a comparison with a regional non-teaching hospital. Economy of drugs is a tempting suggestion to make in view of the high proportion accounted for by halothane. It must

be assumed, however, that specialist anaesthetists are using the techniques of their choice only after being convinced of their pharmacological superiority.

I wish to thank Dr. J. A. Thornton, head of the department of anaesthesia, for his advice and criticism; members of the finance department and pharmacy staffs for answering innumerable questions; and Mr. A. S. Foster for the illustration.

REFERENCES

- Jones, C. S. (1957). *S. Afr. med. J.*, **31**, 906.
 — (1961). *Ibid.*, **35**, 747.
 Seale, J. R. (1959). *Lancet*, **2**, 555.
 — (1960a). *Ibid.*, **1**, 1399.
 — (1960b). *Ibid.*, **2**, 696.
 Shackleton, P. (1960). *Anaesthesia*, **15**, 229.
 Stark, D. C. C., and Pask, E. A. (1962). *Ibid.*, **17**, 195.

CONFERENCES AND MEETINGS

Training of Specialists

A conference on "The Training of Specialists" was held at the Royal College of Physicians, London, on 31 October and 1 November. It was sponsored by the six Royal Colleges, and the 92 invited participants were drawn from the Universities (mostly represented by their Postgraduate Deans) and the Committee of Vice-Chancellors and Principals; the Royal Colleges of England and Scotland, the Colleges of General Practice and of Pathology, and the Royal Medico-Psychological Association; the Scottish Postgraduate Medical Association and the British Postgraduate Medical Federation; the Ministry of Health, the Scottish Home and Health Department, and the Ministry of Health for Northern Ireland; the Regional Hospital Boards, the Central Consultants and Specialists Committee, and the British Medical Association; the General Medical Council, the Medical Research Council, the University Grants Committee, the Association for the Study of Medical Education, the Royal Commission on Medical Education, the Nuffield Provincial Hospitals Trust, and King Edward's Hospital Fund; and six representatives of hospital junior staff, whose presence and comments sharpened the point of much that was discussed.

In his opening remarks Professor M. L. ROSENHEIM emphasized that arrangements for the conference had been well in hand before the "freeze" and before the rumblings of disquiet in the ranks of hospital doctors in the National Health Service had reached their present level, that vocational training had received little attention compared with continuing education, and that ideas appeared ready to crystallize on various subjects—including the career structure in the N.H.S., the optimal number of registrars, and the provision of training posts for general practitioners. Moreover, the lack of a proper career structure for registrars encouraged the emigration of hospital doctors. The working party being set up by the Ministry of Health

and the Joint Consultants Committee might provide a ready outlet for ideas expressed and conclusions reached by the conference.

Present Situation

The first morning was devoted to a review of the present situation. Mr. F. W. HOLDSWORTH told of the Royal College of Surgeons' experience with their pilot scheme of regional tutors. This had been started in 1963 to work with the regionally disposed panel of surgical advisers which since 1959 had created a link between the fifteen regions and the Council of the Royal College of Surgeons. The interest of both regional boards and postgraduate deans of universities in a similar field had led to some initial confusion, but liaison was improving. Mr. Holdsworth pointed out that there were difficulties in arranging for teaching at regional board hospitals because of the heavy work load of their consultant staff and of their registrars in training, and the attendances at meetings varied unpredictably in place and time. He suggested that there was a need to decide which posts were training posts, and to organize them so that rotation through them could provide a minimum adequate training in any surgical specialty. Surgeons occupied a special position because of their need for the acquisition of technique which could be taught only by apprenticeship.

Sir JOHN PEEL described the work of the Royal College of Obstetricians and Gynaecologists in laying down schedules of training and recognition of individual training appointments in hospitals not only at home but also overseas, where 50% of the members of his College worked. Professor C. H. G. MACAFEE's recent review had led him to the conclusion that there was little or no organized training in existence with the exception of a few excellent centres—though he believed

that there had been some improvement in the last year. Both speakers referred to the interference with training by an excessive work load, and noted that the old system of expecting each trainee to fend for himself left gaps in experience and led to waste of precious time.

Mr. A. B. KERR spoke of the existing arrangements for postgraduate education in Scotland, and paid tribute to the stimulus provided by the Nuffield Provincial Hospitals Trust. He commented on the pioneering activities of the Glasgow Board in the field of television, and noted that the Royal Colleges in Edinburgh and Glasgow functioned as a hub of diverse teaching activities because of their readily accessible libraries and museum.

In the course of discussion at this session it emerged that the Ministry of Health had authorized payment for travelling expenses of registrars attending teaching occasions held a long way from their hospital. Previously this expense, in Dr. S. R. F. WHITTAKER's view, had deterred many from making the journey, even if they were able to find the time.

Considering the preregistration year, Dr. M. I. A. HUNTER felt that the work load was too heavy. There was restricted experience in special units, especially in teaching hospitals, and unnecessary time was spent in clerical routine and collection of blood samples. The best students tended to get jobs at their own teaching hospitals, and hence in his view there was an added responsibility to take care of those who did not. Some form of inter-regional observation was needed to take account of what happened across regional boundaries. Dr. Hunter approved of third-year clinical students acting as supernumerary house-physicians, and he felt that practical techniques—such as giving intravenous infusions and the treatment of cardiac arrest—should be learned before a house-physician took up his appointment.